ISSN 1809-127X (online edition)
© 2010 Check List and Authors
Open Access | Freely available at *www.checklist.org.br*

Check List
Journal of species lists and distribution

LISTS OF SPECIES

Anurans and Lizards, Rio Preto da Eva, Amazonas, Brazil

Paulo Ilha* and Marianna Dixo

Universidade de São Paulo, Instituto de Biociências, Departamento de Ecologia. Rua do Matão, Travessa 14 s/n, Caixa Postal 11461. CEP 05508-900. São Paulo, SP, Brazil.
* Corresponding author. E-mail: *ilha@ib.usp.br*

ABSTRACT: This study presents a list of anurans and lizards of a Central Amazonian *terra-firme* rainforest site at *Rio Preto da Eva,* Amazonas, Brazil sampled for 38 days from December 2003 to February 2004. The study area is located close to highway AM-010 (Manaus-Itacoatiara), where deforestation represents the main threat to the local biota. Using two complementary sampling methods, active search and pitfall traps with drift fence, we recorded 23 anuran species in 12 genera and six families and 20 lizard species in 16 genera and seven families. Relative to other sites in Central Amazon, our study site presented a similar number of species of lizards but fewer amphibians.

INTRODUCTION

The Amazon is the largest and more diverse tropical forest in the world (WWF 2007) and 60 % of its territory is contained in Brazil (IBGE 2008). Today, 221 species of anurans and 94 of lizards are known in the Brazilian Amazon (Ávila-Pires *et al.* 2007). However, most information is preliminary and basic herpetological knowledge is lacking from many regions, including those presumably well sampled such as the region of Manaus (Gordo 2003). Amphibians are currently considered the most threatened class of vertebrates, and many species declined and disappeared in recent years due to habitat loss and fragmentation, among other causes (IUCN *et al.* 2007). Lizards also may be declining (Gibbons *et al.* 2000) and are likewise affected by habitat loss, fragmentation and disturbance (Rodrigues 2005).

Habitat loss and fragmentation represent the major threats to the Amazonian fauna (Tabarelli and Gascon 2005): 12 % of the original forest cover had been removed by 2004 and it is estimated that 25 % will be cleared until 2025 (WWF 2007). Forest clearing in the Amazon is often associated with road construction. Two-thirds of all forest clearing in the Amazon is within 50 km of a major road (Alves 2002), and these major roads generally spawn secondary road networks with settlement and deforestation gradually spreading outward from the initial cuts through the landscape (Mertens *et al.* 2002). Thus, landscapes around roads are more likely to be deforested (Kirby *et al.* 2006) or subject to other impacts on biotic integrity (Trombulak and Frissell 2000).

The aim of this article is to present a species list of anurans and lizards occurring in a *terra-firme* site located by Highway AM-010, in the municipality of Rio Preto da Eva, Amazonas, Brazil. Information about species diversity and distribution are essential to the understanding of biodiversity and biogeography, and therefore to the outline of appropriate conservation strategies (Haddad 1998). As the Amazonian rainforest is increasingly devastated, it is very important to increase the number of sites for which species occurrences can be estimated (da Silva and Sites 1995).

MATERIAL AND METHODS

Study area

Sampling was conducted in a private property (2°20'30" S, 59°12'52" W) located along side km 160 on Highway AM-010 (Manaus-Itacoatiara), in the municipality of Rio Preto da Eva, east of Manaus, state of Amazonas, Brazil (Figure 1). The study area comprises 1,100 ha of *terra-firme* rainforests (including two artificial lakes and four small streams 1-4 m wide), where deforestation represents the main threat to the local biota. The relief is uniform, with uplands up to twenty meters higher than stream valleys. The climate is hot and wet, with annual mean temperatures around 26 °C, relative air humidity over 80 %, and over 2,000 mm of rainfall mostly concentrated between November and May (Leopoldo *et al.* 1987).

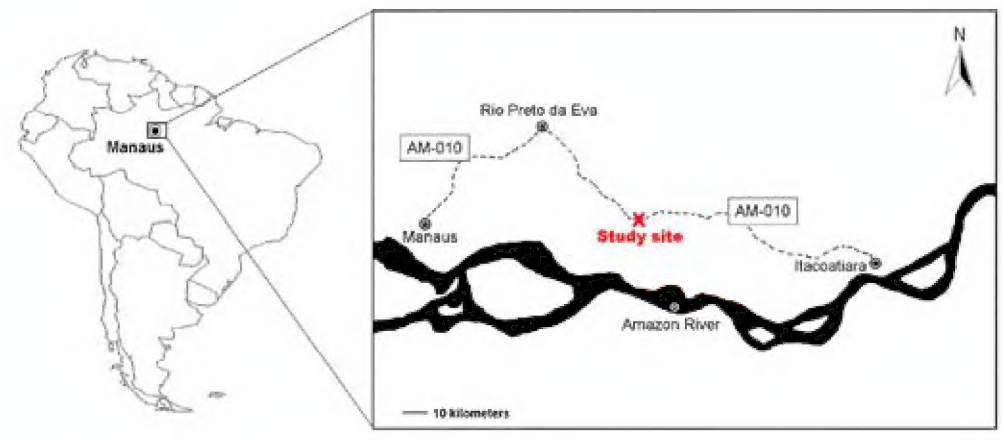


FIGURE 1. Location of the study site in Rio Preto da Eva, Amazonas, Brazil.

Data collection

We sampled anurans and lizards in 38 days of fieldwork from December 2003 to February 2004 using two complementary methods: active search and capture, and passive capture with pitfall traps with drift fence (Fitch 1987; Cechin and Martins 2000). Active search was conducted both during day and night hours and included occasional sightings as well as searches in potential retreats (*e.g.*, under rocks and fallen logs) and breeding sites. There was no standardization of sampling effort with this method. Pitfall traps were installed in primary and secondary forests. Six stations were constructed, three in uplands and three in stream valleys in order to sample

the different habitats present in the area. Each station consisted of four 30-L buckets and four 60-L buckets alternated, and connected by a ten meter polyethylene fence-guide 100 cm high, resulting in a 70-meter-long line. The distance of traps from the road varied from 1 to 5 km. Traps were checked daily, totaling 2,496 buckets-day total effort. Voucher specimens were preserved in 10 % formalin and later transferred to 70 % ethanol, and will be deposited at the *Museu de Zoologia da Universidade de São Paulo* (collecting permit number 017/04 – IBAMA RAN process 02027.011465/99-25). Species identification was determined by specialists and literature (Lima et al. 2006; Vitt et al. 2008).

Results and Discussion

We recorded 23 anuran species in 12 genera and six families (Table 1; Figures 2-4). Hylidae and Leptodactylidae were the families with more species at the study site, as is typical for the Neotropical region in general (Duellman 1988), and for many Brazilians biomes in particular (Haddad and Sazima 1992; Brandão and Araújo 1998; Bernarde and Machado 2000; Izecksohn and Carvalho-e-Silva 2001; Pombal and Gordo 2004). Total number of species recorded in this study was considerably smaller than that found in other Central Amazonian sites: 53 in the Rio Madeira (Heyer 1977), 45 in Roraima (Martins 1998), 43 in the Rio Purus (Gordo 2003), in the Manaus region, 42 (Zimmerman and Rodrigues 1990) and 47 (Zimmermann and Simberloff 1996) in INPA-WWF Reserves, and 50 in Reserva Adolpho Ducke (Lima *et al.* 2006). This smaller number of species is not unexpected, considering that this preliminary study was limited in area, duration, and diversity of sampling methods. Tropical forests have to be sampled multiple times in multiple seasons across multiple years to obtain complete species lists (Donnelly *et al.*

Table 1. Anuran species recorded in the study site.

Family	Species
Aromobatidae	*Anomaloglossus stepheni* (Martins, 1989)
Bufonidae	*Dendrophryniscus minutus* Melin, 1941
	Rhinella proboscidea (Spix, 1824)
	Rhinella marina (Linnaeus, 1758)
Hylidae	*Dendropsophus minutus* (Peters, 1872)
	Hypsiboas cinerascens (Spix, 1824)
	Hypsiboas geographicus (Spix, 1824)
	Osteocephalus oophagus Jungfer and Schiesari, 1995
	Osteocephalus taurinus (Steindachner, 1862)
	Phyllomedusa bicolor (Boddaert, 1772)
	Phyllomedusa tarsius (Cope, 1868)
	Scinax boesemani (Goin, 1966)
	Scinax ruber (Laurenti, 1768)
	Trachycephalus resinifictrix (Goeldi, 1907) *
Leptodactylidae	*Leptodactylus andreae* (Muller, 1923)
	Leptodactylus hylaedactylus (Cope, 1868)
	Leptodactylus knudseni Heyer, 1972
	Leptodactylus lineatus (Schneider, 1799)
	Leptodactylus longirostris (Boulenger, 1882)
	Leptodactylus pentadactylus (Laurenti, 1768)
	Leptodactylus riveroi Heyer and Pyburn, 1983
Microhylidae	*Synapturanus mirandaribeiroi* Nelson and Lescure, 1975
Strabomantidae	*Pristimantis fenestratus* (Steindachner, 1864)

* Only calling record, no specimens collected.

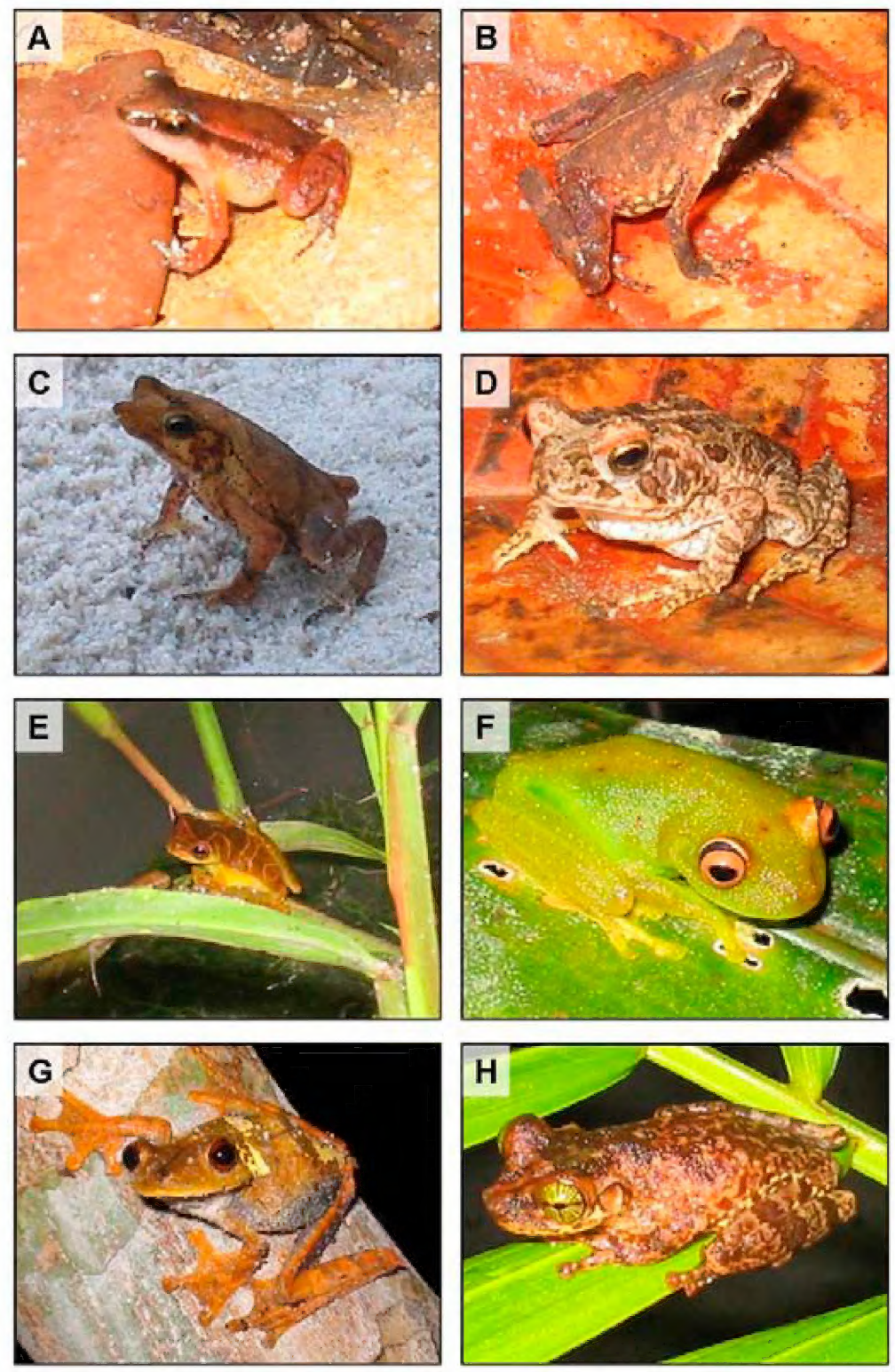


Figure 2. Some species of anurans from *Rio Preto da Eva*. **(A)** *Anomaloglossus stepheni*; **(B)** *Dendrophryniscus minutus*; **(C)** *Rhinella proboscidea*; **(D)** *Rhinella marina* (juvenile); **(E)** *Dendropsophus minutus*; **(F)** *Hypsiboas cinerascens*; **(G)** *Hypsiboas geographicus*; **(H)** *Osteocephalus oophagus*.

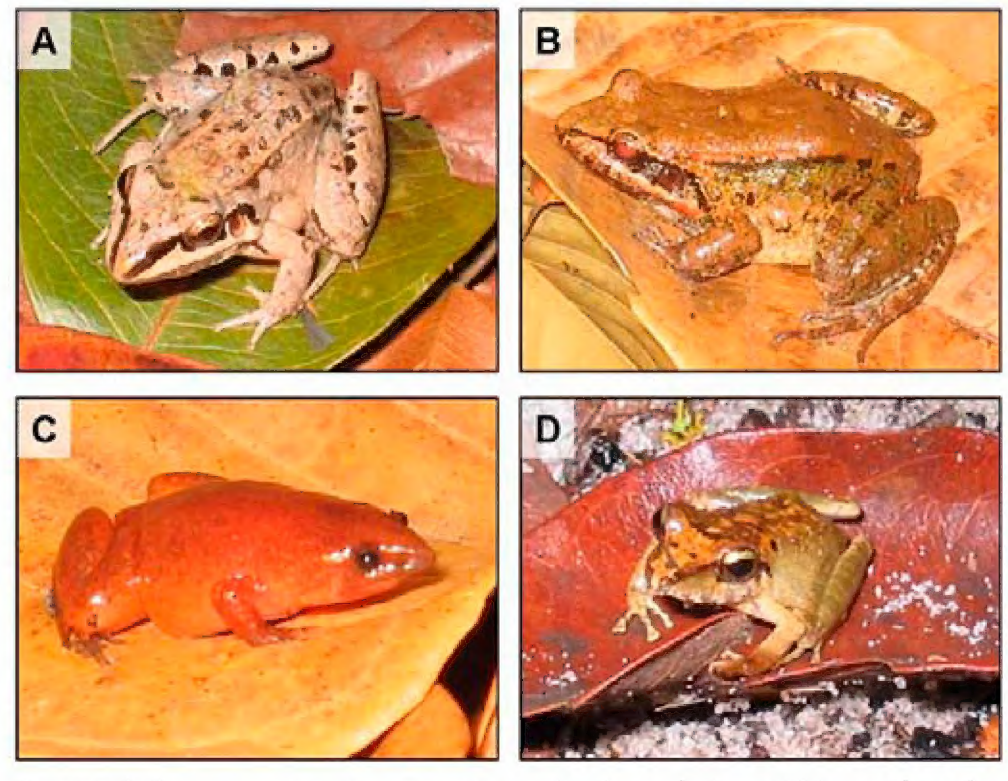


Figure 3. Some species of anurans from *Rio Preto da Eva*. **(A)** *Leptodactylus longirostris*; **(B)** *Leptodactylus riveroi*; **(C)** *Synapturanus mirandaribeiroi*; **(D)** *Pristimantis fenestratus.*

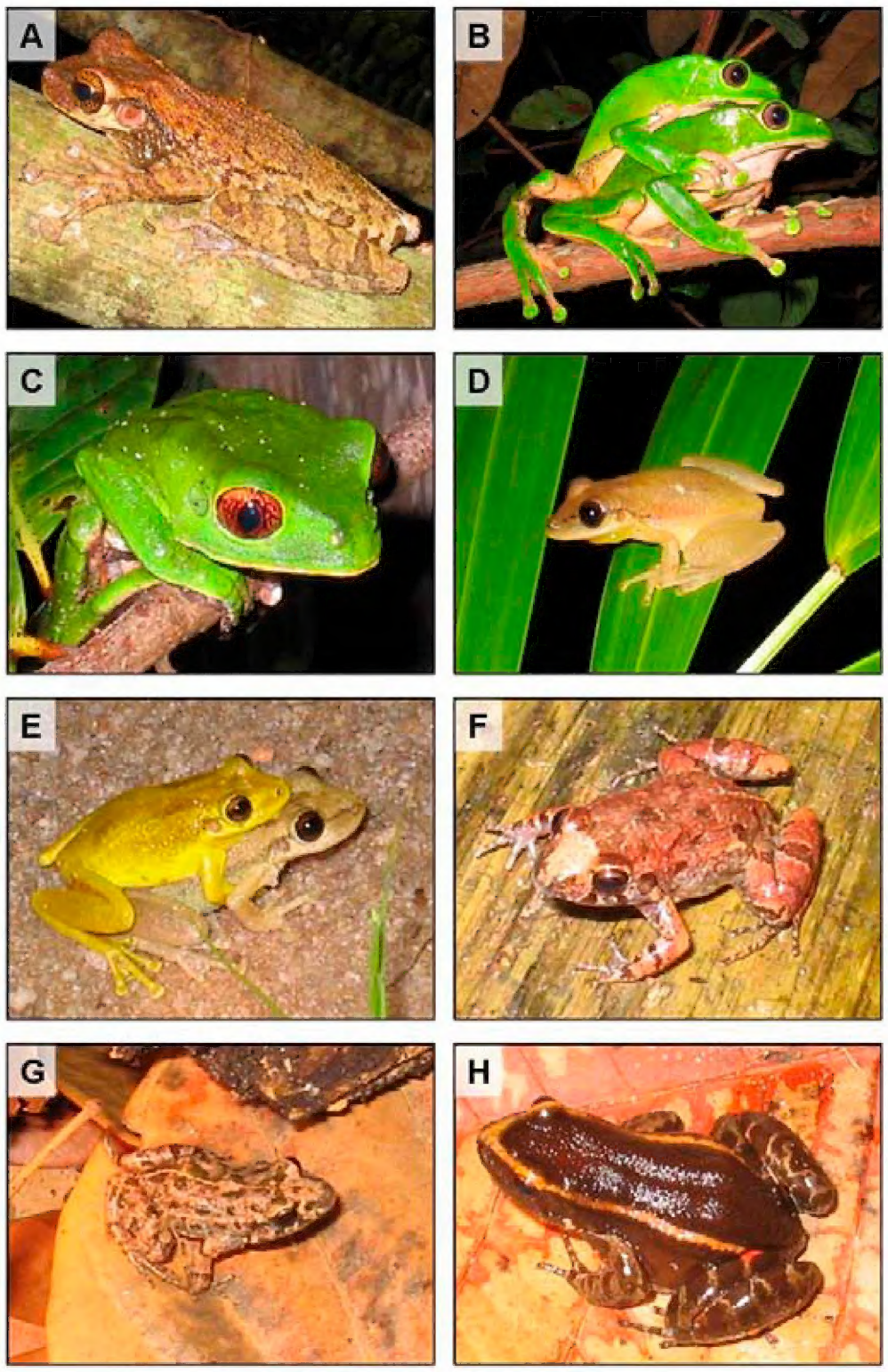


FIGURE 4. Some species of anurans from *Rio Preto da Eva*. **(A)** *Osteocephalus taurinus*; **(B)** *Phyllomedusa bicolor*; **(C)** *Phyllomedusa tarsius*; **(D)** *Scinax boesemani*; **(E)** *Scinax ruber*; **(F)** *Leptodactylus andreae*; **(G)** *Leptodactylus hylaedactylus*; **(H)** *Leptodactylus lineatus*.

2005), and as such short-term ecological studies are unlikely to capture the true picture of the herpetofaunal diversity (Doan and Arriaga 2002). In addition, amphibian diversity depends on habitat diversity, with larger areas containing a higher diversity of species for including a higher diversity of habitat types (Ricklefs and Lovette 1999). Thus, the limited temporal scale of our samples (38 days when compared to more than four years in Zimmerman and Rodrigues 1990), as well as our limited spatial scale (2-8 km of trails sampled when compared to 106 km in Zimmermann and Simberloff (1996) or 64 km^2 in Lima *et al.* 2006) should be an important explanation for the smaller diversity found in this study.

We recorded 20 lizard species in 16 genera and 7 families (Table 2; Figures 5-6). Although approximately 100 lizard species are known to occur in the Amazon as a whole, local species richness for lowland Amazonian forest sites typically ranges from 20 to 40 (Vitt *et al.* 1998). The total species number registered in Rio Preto da Eva was similar to that found in some other Amazonian sites: 23 in Manaus (Zimmerman and Rodrigues 1990), 21 in Belém

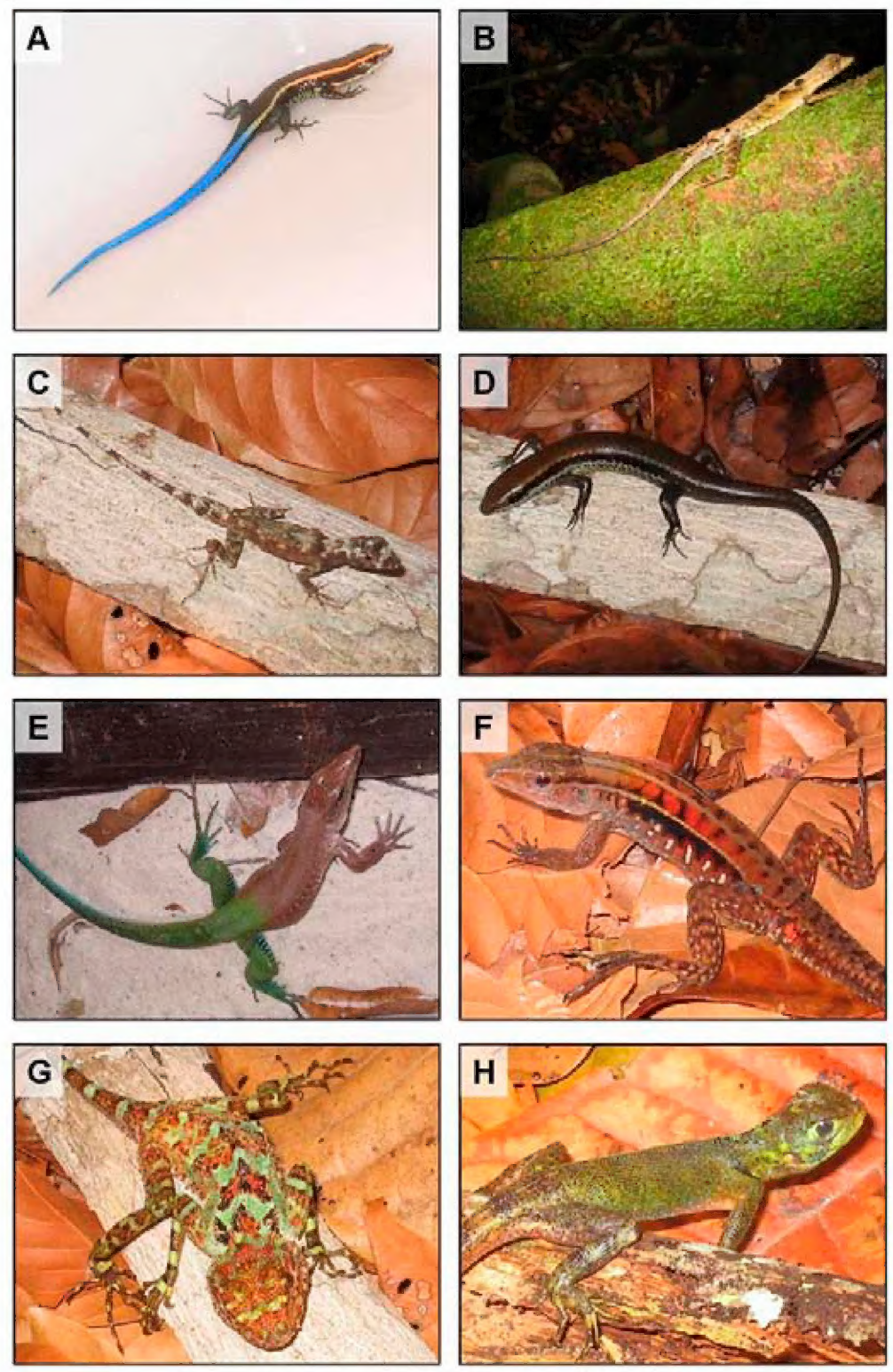
<<

FIGURE 5. Some species of lizards from *Rio Preto da Eva*. **(A)** *Tretioscincus agilis*; **(B)** *Anolis nitens*; **(C)** *Anolis ortonii*; **(D)** *Mabuya nigropunctata*; **(E)** *Ameiva ameiva*; **(F)** *Kentropyx calcarata*; **(G)** *Plica plica*; **(H)** *Plica umbra*.

TABLE 2. Lizard species recorded in the study site.

Family	Species
Gekkonidae	*Hemidactylus mabouia* (Moreau de Jonnês, 1818)
Gymnophthalmidae	*Arthrosaura reticulata* (O'Shaughnessy, 1881)
	Iphisa elegans Gray, 1851
	Leposoma percarinatum (Müller, 1923)
	Neusticurus bicarinatus (Linnaeus, 1758)
	Tretioscincus agilis (Ruthven, 1916)
Polychrotidae	*Anolis philopunctatus* Rodrigues, 1988
	Anolis fuscoauratus D'Orbigny, 1837
	Anolis nitens (Wagler, 1830)
	Anolis ortonii Cope, 1868
Scincidae	*Mabuya nigropunctata* (Spix, 1825)
Sphaerodactylidae	*Coleodactylus amazonicus* (Andersson, 1918)
	Gonatodes humeralis (Guichenot, 1855)
	Pseudogonatodes guianensis (Parker, 1935)
Teiidae	*Teiidae Ameiva ameiva* (Linnaeus, 1758)
	Cnemidophorus sp. *
	Kentropyx calcarata Spix, 1825
	Tupinambis teguixin (Linnaeus, 1758) *
Tropiduridae	*Plica plica* (Linnaeus, 1758)
	Plica umbra (Linnaeus, 1758)

* Only visual record, none specimen was collected.



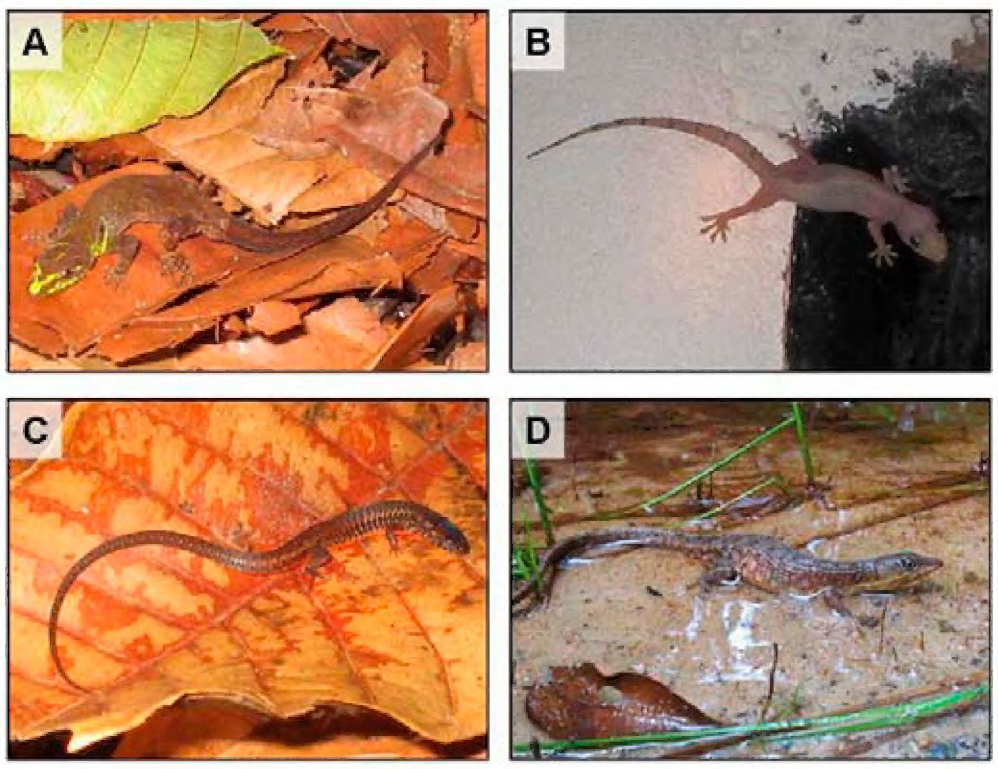


Figure 6. Some species of lizards from *Rio Preto da Eva*. **(A)** *Gonatodes humeralis*; **(B)** *Hemidactylus mabouia*; **(C)** *Arthrosaura reticulata*; **(D)** *Neusticurus bicarinatus.*

and Balbina (Rand and Humphrey 1968; Martins 1991), 20 in Carajás (Cunha *et al.* 1985).

Although preliminary, the inventory presented in this article is a contribution to the understanding of the distributions of Central Amazonian anurans and lizards, and therefore to their conservation (Azevedo-Ramos and Galatti 2002). In a temporal perspective, this inventory provides the necessary historical baseline for future studies that aim to understand the consequences of infrastructure development in Central Amazon in general and around highway AM-010 in particular.

Acknowledgments: We thank Marcio Martins for supervision and logistical support, Marcelo Gordo for logistical support and specimen identification, Leopoldo Dias Junior for encouragement and support, Luis Schiesari for English revision and suggestions, and all those who helped in the field work. We also thank FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo, Processo 04/13197-8) for financial support.

Literature cited

Alves, D. S. 2002. An analysis of the geographical patterns of deforestation in the Brazilian Amazonia in the 1991-1996 period; p. 95-106 In C. H. Wood and R. Porro (ed). *Deforestation and Land Use in the Amazon*. Gainesville: University Press of Florida.

Ávila-Pires, T. C. S., M. S. Hoogmoed and L. J. Vitt. 2007. Herpetofauna da Amazônia; p 13-43 In L. B. Nascimento and M. E. Oliveira (ed.). *Herpetologia no Brasil 2*. Belo Horizonte: Sociedade Brasileira de Herpetologia.

Azevedo-Ramos, C. and U. Galatti. 2002. Patterns of amphibian diversity in Brazilian Amazonia: conservation implications. B*iological Conservation* 103: 103–111.

Bernarde, P. S. and R. A. Machado. 2000. Riqueza de espécies, ambientes de reprodução e temporada de vocalização da anurofauna em Três Barras do Paraná, Brasil (Amphibia: Anura). *Cadernos de Herpetologia* 14(3): 93-104.

Brandão, R. A. and A. F. B. Araújo. 1998. Herpetofauna de Águas Emendadas; p. 6-16 In J. Marinho-Filho, F. Rodrigues, M. Guimarães (ed.). *Vertebrados da Estação Ecológica de Águas Emendadas.* Brasília: SEMATEC/IEMA.

Cechin, S. Z. and M. Martins. 2000. Eficiência de armadilhas de queda (pitfall traps) em amostragens de anfíbios e répteis no Brasil. *Revista Brasileira de Zoologia* 17: 729-740.

Cunha, O. R., F. P. Nascimento and T. C. S. Ávila-Pires. 1985. Os répteis da área de Carajás, Pará, Brasil (Testudines e Squamata). *Publicações avulsas do Museu Paraense Emílio Goeldi* 40: 9-92.

da Silva, N. J. and J. W. Sites. 1995. Patterns of Diversity of Neotropical Squamate Reptile Species with Emphasis on the Brazilian Amazon and the Conservation Potential of Indigenous Reserves. *Conservation Biology* 9(4): 873-901.

Doan, T. M. and W. A. Arriaga. 2002. Microgeographic Variation in Species Composition of the Herpetofaunal Communities of Tambopata Region, Peru. *Biotropica* 34(1): 101–117.

Donnelly, M. A., M. H. Chen and G. G. Watkins. 2005. Sampling amphibians and reptiles in the Iwokrama Forest ecossystem. *Proceedings of the Academy of Natural Sciences of Philadelphia* 154: 55-69.

Duellman, W. E. 1988. Patterns of species diversity in anuran amphibians in the American Tropics. *Annals of the Missouri Botanical Garden* 75: 79-104.

Fitch, H. S. 1987. Collecting and life-history techniques; p. 143-164 In R. A. Seigel, J. T. Collins, and S. S. Novak (ed.). *Snakes: Ecology and Evolutionary Biology*. New York: McGraw-Hill.

Gibbons, J. W., D. E. Scott, T. J. Ryan, K. A. Buhlmann, T. D. Tuberville, B. S. Metts, J. L. Greene, T. Mills, Y. Leiden, S. Poppy and C. Winne. 2000. The global decline of reptiles, Déjà Vu amphibians. *BioScience* 50: 653-666.

Gordo, M. 2003. Os anfíbios anuros do Baixo Rio Purus/Solimões; p. 243-256 In: C. P. de Deus; R. Da Silveira; L. H. R. Py-Daniel (ed.). Piagaçu-Purus: *Bases científicas para a criação de uma Reserva de Desenvolvimento Sustentável*. Manaus: Instituto de Desenvolvimento Sustentável Mamirauá.

Haddad, C.F.B. 1998. Biodiversidade dos anfíbios no estado de São Paulo; p 15-26 In C. A. Joly and C. E. M. Bicudo (ed.). *Biodiversidade do Estado de São Paulo, Brasil: síntese do conhecimento ao final do século XX*. 6: Vertebrados. São Paulo: FAPESP.

Haddad, C. F. B. and I. Sazima. 1992. Anfíbios Anuros da Serra do Japi; p. 188-211 In L. P. C. Morellato (ed.). *História Natural da Serra do Japi: Ecologia e preservação de uma Área Florestal no Sudeste do Brasil*. Campinas: Editora da UNICAMP/FAPESP.

Heyer, W. R. 1977. Taxonomic Notes on Frogs from the Madeira e Purus Rivers, Brazil. *Papéis Avulsos de Zoologia* 31(8): 141-162.

IBGE. 2008. Electronic Database accessible at <http://www.ibge.gov.br>. Captured on 12 February 2008.

IUCN, Conservation International, and NatureServe. 2007. Global Amphibian Assessment. Electronic Database accessible at <http://www.globalamphibians.org>. Captured on 29 March 2007.

Izecksohn, E. and S. P. Carvalho-e-Silva. 2001. *Anfíbios do Município do Rio de Janeiro*. Rio de Janeiro: Editora UFRJ.

Kirby, K. R., W. F. Laurance, A. K. Albernaz, G. Schroth, P. M. Fearnside, S. Bergen, E. M. Venticinque and C. Costa. 2006. The future of deforestation in the Brazilian Amazon. *Futures* 38: 432–453.

Leopoldo, P. R., W. Franken, E. Salati and M. N. G. Ribeiro. 1987. Towards a water balance in Central Amazonian region. *Experientia* 43: 222-233.

Lima, A. P., W. E. Magnusson, M. Menin, L. K. Erdtmann, D. J. Rodrigues, C. Keller and W. Hödl. 2006. *Guia de Sapos da Reserva Adolpho Ducke, Amazônia Central* (= Guide to the frogs of Reserva Adolpho Ducke, Central Amazonia). Manaus: Áttema Design Editorial.

Martins, M. 1991. The lizards of Balbina, Central Amazônia, Brazil: a qualitative analysis of resourse utilization. *Studies on Neotropical Fauna and Environment* 26(3): 179-190.

Martins, M. 1998. The frogs of the Ilha de Maracá; p. 285-306 In W. Milliken and J. A. Ratter (ed.). *Maracá: biodiversity and environment of an Amazonian rainforest*. New York: John Wiley and Sons.

Mertens, B., R. Poccard-Chapuis, M.-G. Piketty, A.-E. Laques and A. Venturieri. 2002. Crossing spatial analyses and livestock economics to understand deforestation processes in the Brazilian Amazon: the case of São Felix do Xingu in South Pará. *Agricultural Economics* 27: 269–294.

Pombal, J. R. and M. Gordo. 2004. Anfíbios Anuros da Juréia; p. 243-256 In O. A. V. Marques e W. Duleba (ed.). *Estação Ecológica Juréia-Itatins. Ambiente Físico, Flora e Fauna*. Ribeirão Preto: Holos Editora.

Rand, A. S. and S. S. Humphrey. 1968. Interespecific competition in the tropical rain forest: ecological distribution among lizards at Belém, Pará. *Proceedings of the United States National Museum* 125: 1-17.

Ricklefs, R. E. and I. J. Lovette. 1999. The roles of islands area per se and habitat diversity in the species-área relationships of four Lesser Antillean fournal groups. *Journal of Animal Ecology* 68: 1142-1160.

Rodrigues M. T. 2005. Conservação dos répteis brasileiros: os desafios para um país megadiverso. *Megadiversidade* 1: 87-94.

Tabarelli, M. and C. Gascon. 2005. Lições da pesquisa sobre fragmentação: aperfeiçoando políticas e diretrizes de manejo para a conservação da biodiversidade. *Megadiversidade* 1(1): 181-188.

Trombulak, C. S. and A. C. Frissel. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. *Conservation Biology* 14(1): 18-30.

Vitt, L. J., T. C. Ávila-Pires, J. P. Caldwell, and V. R. L. Oliveira. 1998. The Impact of Individual Tree Harvesting on Thermal Environments of Lizards in Amazonian Rain Forest. *Conservation Biology* 12(3): 654-664.

Vitt, L., W. E. Magnusson, T. C. Ávila-Pires, A. P. Lima. 2008. *Guia de Lagartos da Reserva Adolpho Ducke, Amazônia Central* (= Guide to the Lizards

of Reserva Adolpho Ducke, Central Amazônia). Manaus: Áttema Design Editorial.

WWF. 2007. Principais ameaças ao bioma Amazônia. Electronic Database accessible at <http://www.wwf.org.br>. Captured on 11 August 2007.

Zimmerman, B. L. and D. Simberloff. 1996. An historical interpretation of habitat use by frogs in Central Amazonian Forest. *Jornal of Biogeography* 23(1): 27-46.

Zimmerman, B. L. and M. T. Rodrigues. 1990. Frogs, Snakes, and Lizards of the INPA-WWF Reserves near Manaus, Brasil; p. 426-454 In A. H. Gentry (ed.). *Four Neotropical Rainforests*. New Haven: Yale University Press.

Received: February 2009
Revised: December 2009
Accepted: December 2009
Published online: February 2010
Editorial responsibility: Alejandro R. Giraudo